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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL Missions Overview

Dr. Anita Sengupta

Senior Engineer, Entry Descent and Landing, Mechanical Systems

Jet Propulsion Laboratory
California Institute of Technology

National Aeronautics and
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California Institute of Technology
Pasadena, California

Outline

- NASA's Compelling questions
- What is JPL
- JPL Vision for Space Exploration
- JPL Current Missions
- Recent Scientific findings
- Mars Science Laboratory Mission Overview

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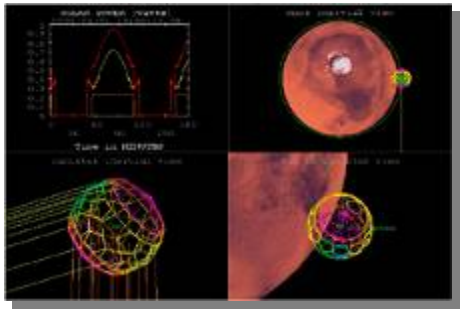
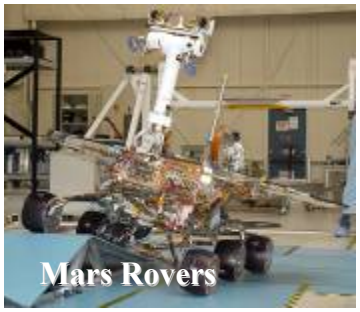
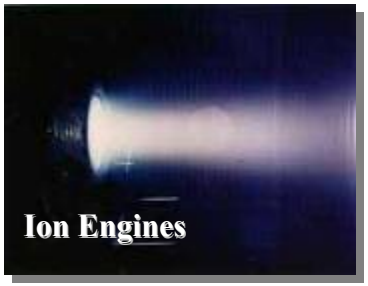
End-to-end capabilities needed to implement missions

Project Formulation - Team X



Mission Design





Spacecraft Development

Integration and Test

Environmental Test

Real Time Operations

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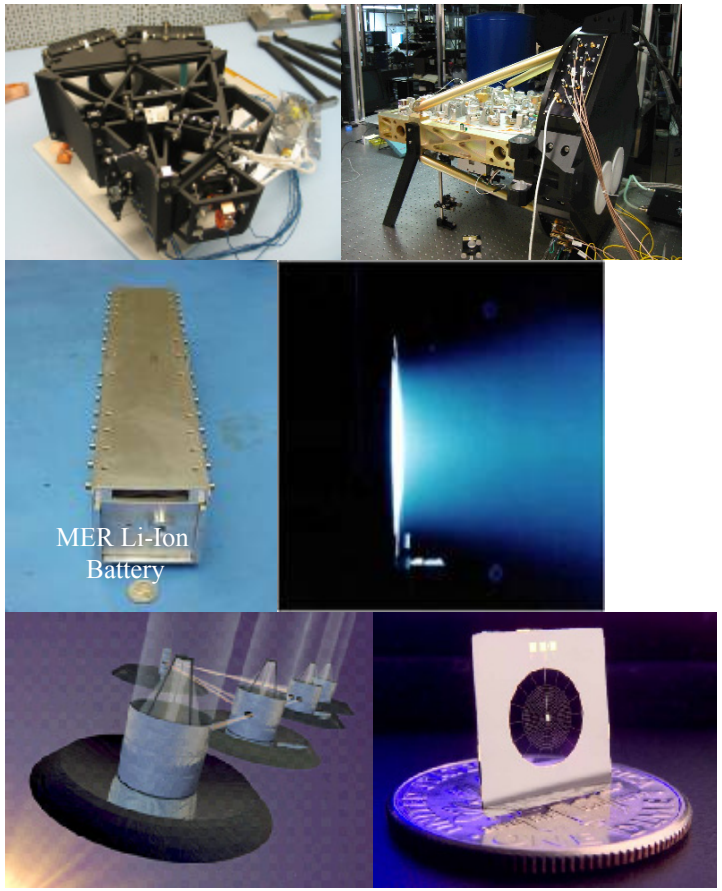
Research and technology Development

- **Technology to enable future missions: Examples:**
  - **Mapping Reflected energy Spectrometer (MaRS):**
    - **Next generation imaging spectrometer for Earth and planetary remote sensing**
  - **Laser Absorption Spectrometer (LAS):**
    - **Global scale profiling of tropospheric carbon dioxide**
  - **Lithium ion battery:**
    - **Large mass and volume savings with improved performance**
  - **Ion engine:**
    - **Long-life (>30,000 hours) mission-enabling characterization**
  - **Formation flying:**
    - **Simulation of mission-enabling technology for Terrestrial Planet Finder, Earth Science and astrophysics applications**
  - **Long wave detectors for astrophysics**
    - **Far infrared and sub-millimeter high sensitivity detectors**



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JPL long-term role in Vision for Exploration

- "Explore the solar system and beyond."
  - Mars exploration program
  - Solar system robotic exploration: outer planets and their moons
  - Search for extra-solar planets
  - Origins program and astrophysics of galaxies and the universe
  - Deep space telecommunications and navigation support
- "Human presence across the solar system."
  - Continuing and increasing support to ESMD Constellation program
- "Innovative technologies, knowledge and infrastructures."
  - Continuing technology developments: telecommunications; planetary entry, descent and landing; navigation, guidance and control; deployable structures; power sources and energy storage; observational instruments; flight and ground computer hardware and software; robotics and autonomy
- "International and commercial participation."
  - Continuing partnerships with commercial and international partners: e.g., MRO built by LMSSC, Huygens Titan lander (on Cassini) by ESA.

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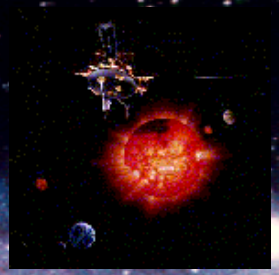
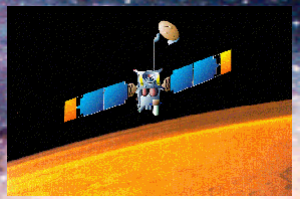
Eighteen spacecraft and five instruments across the solar system (and beyond).

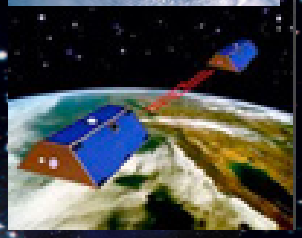
Spitzer studying stars and galaxies in the infrared

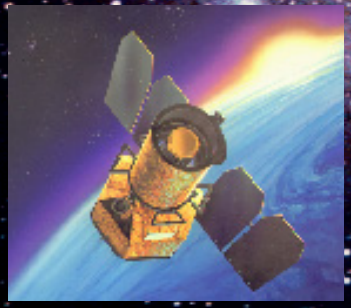




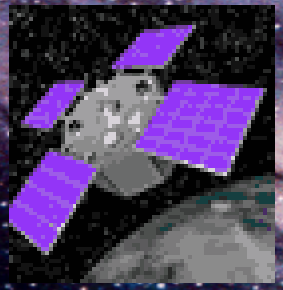
Cassini studying Saturn

Stardust carrier continuing after sample return

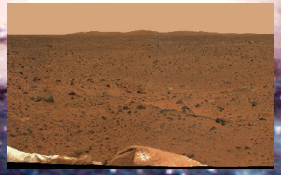


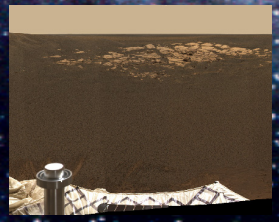


GALEX surveying galaxies in the ultraviolet

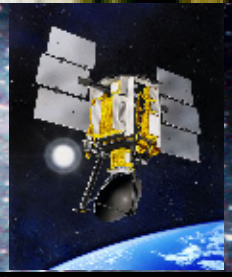


Ulysses and ACRIMSAT studying the sun

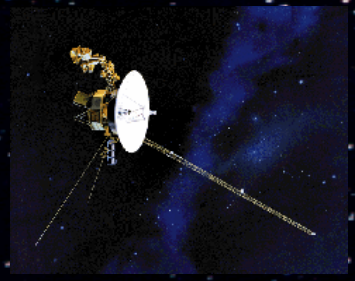




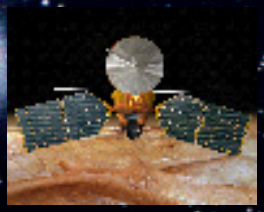
Deep Impact carrier continuing after hitting comet Tempel 1



QuikScat, Jason 1, CloudSat, and GRACE (plus ASTER, MISR, AIRS, MLS and TES instruments) monitoring Earth.



Two Voyagers on an interstellar mission



Mars Global Surveyor, Mars Odyssey, and MRO in orbit around Mars. "Spirit" and "Opportunity" in extended missions.

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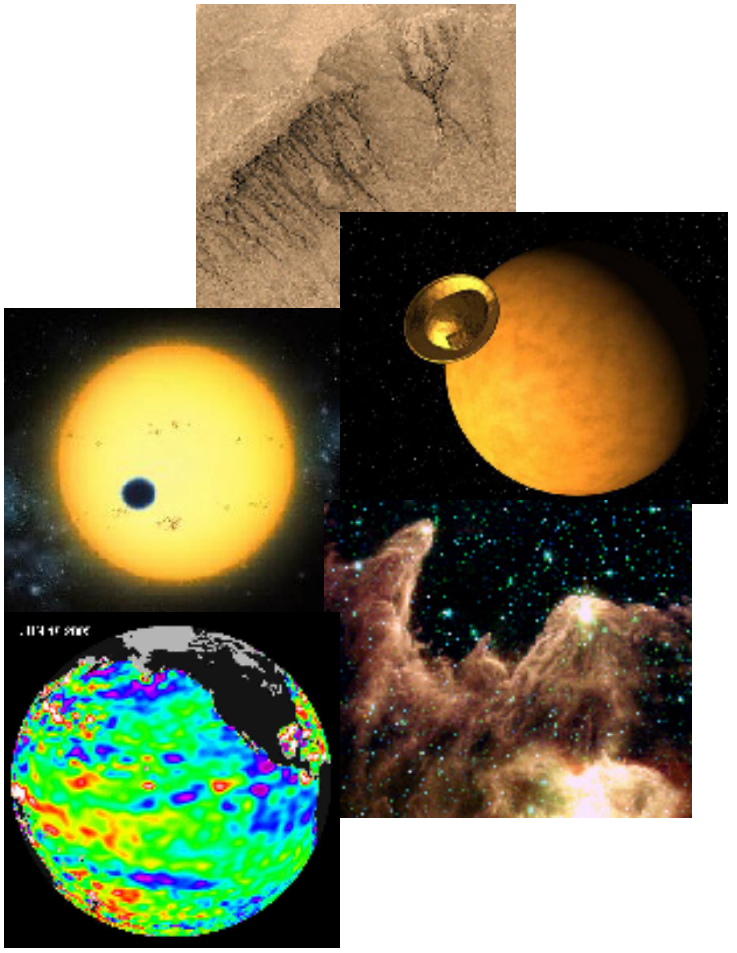
Five major current JPL programs

1. Mars exploration: Follow the water
2. Life-friendly sites in the solar system
3. Extra-solar planets
4. Origins of galaxies and the universe
5. Our home planet, Earth



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Five major current JPL projects

- **In operations:**
  - **Deep Space Network**
  - **Mars:**
    - **Mars Reconnaissance Orbiter**
    - **Mars Exploration Rovers**
    - **Mars Odyssey**
    - **Mars Global Surveyor**
  - **Spitzer Space Telescope**
  - **Cassini Saturn orbiter**
  - **Earth Science:**
    - **Gravity Recovery and Climate Experiment (GRACE)**
    - **Jason ocean elevation**
    - **CloudSat**

- **In development:**
  - **Mars Science Laboratory (2009)**
  - **Space Interferometer Mission –SIM (2015)**
  - **Phoenix Mars polar lander (2007)**
  - **Juno Jupiter orbiter (2010)**
  - **Orbiting Carbon Observatory**

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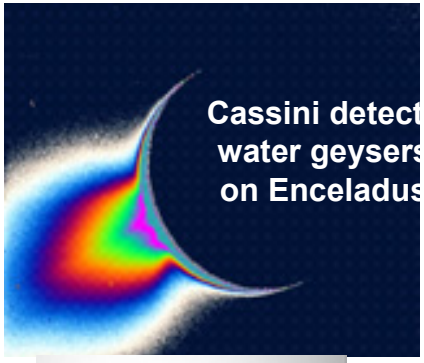
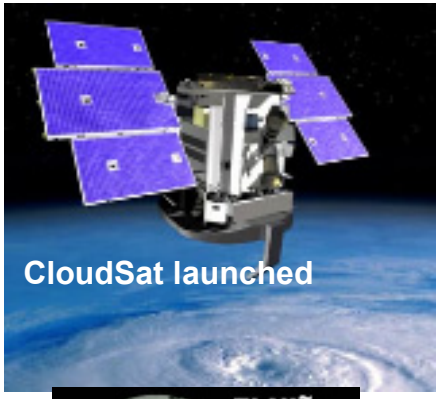
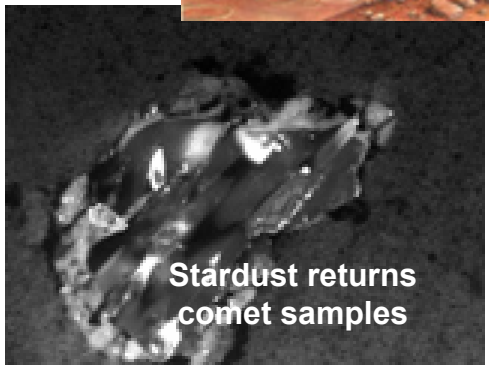
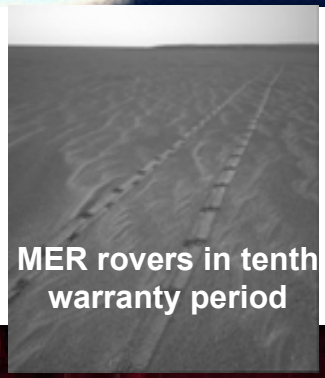
JPL major accomplishments of 2006

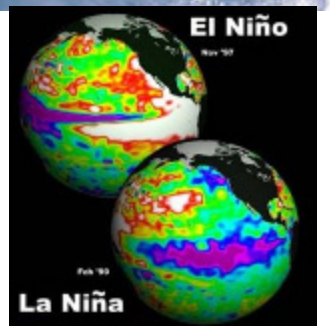
MRO in Mars orbit



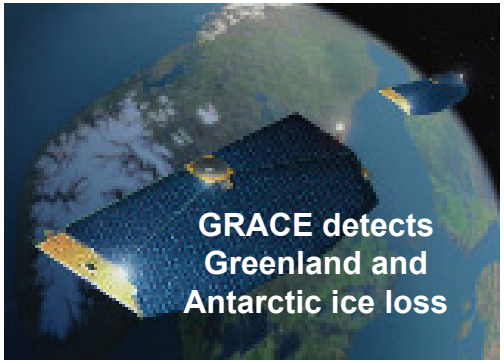








Topex/Poseidon completes 14-year mission



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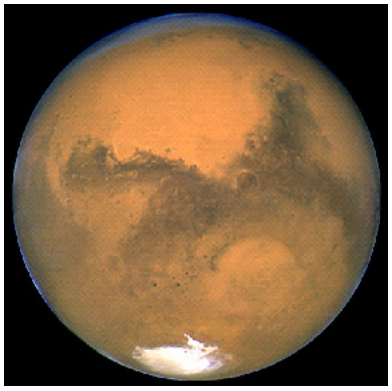
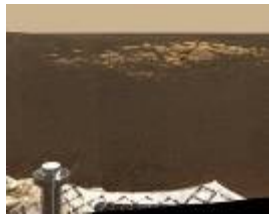
A permanent presence on Mars

Odyssey 2001

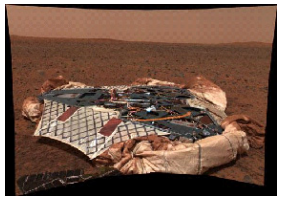
MRO 2005

MGS 1996

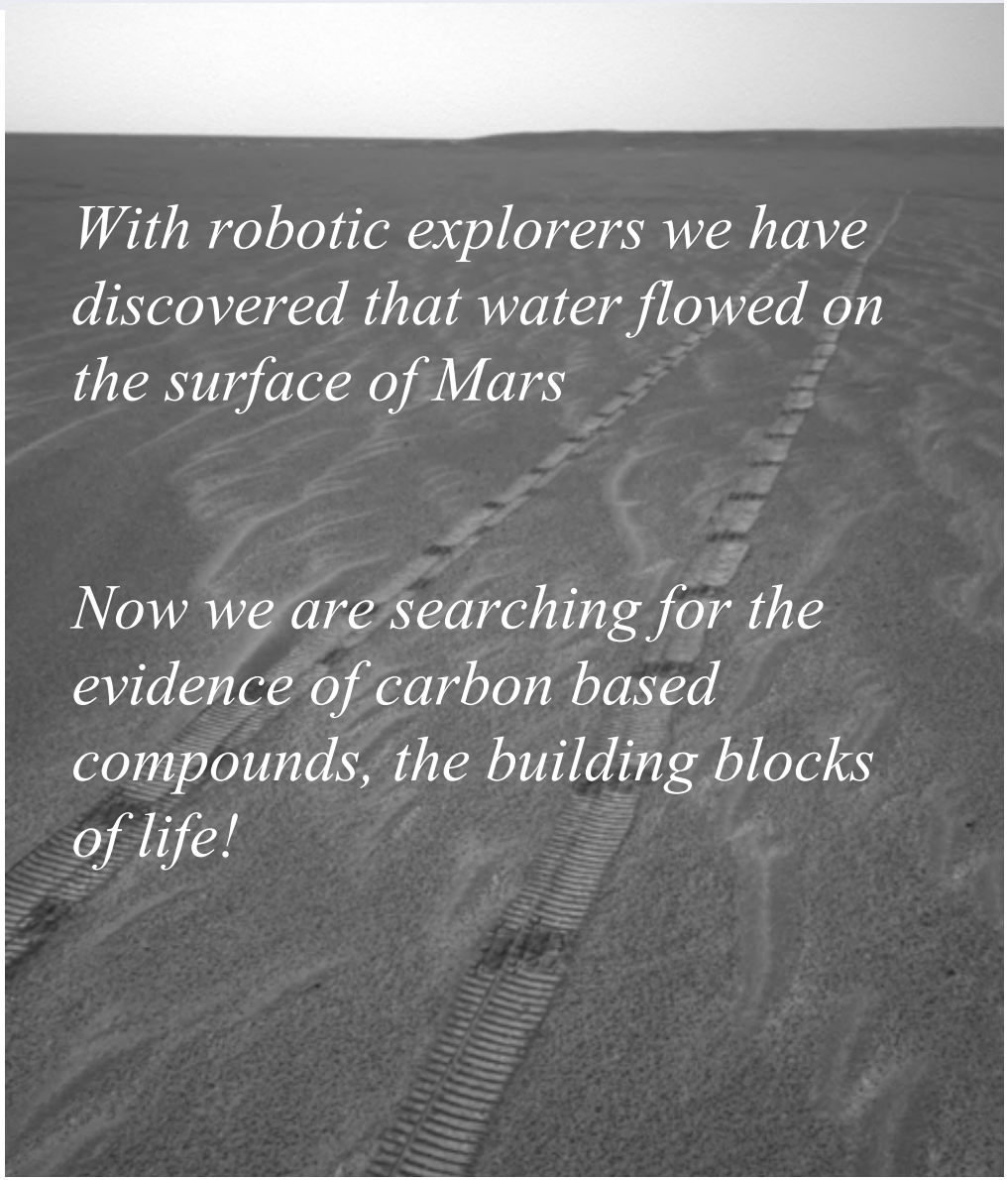




Opportunity 2003



Spirit 2003



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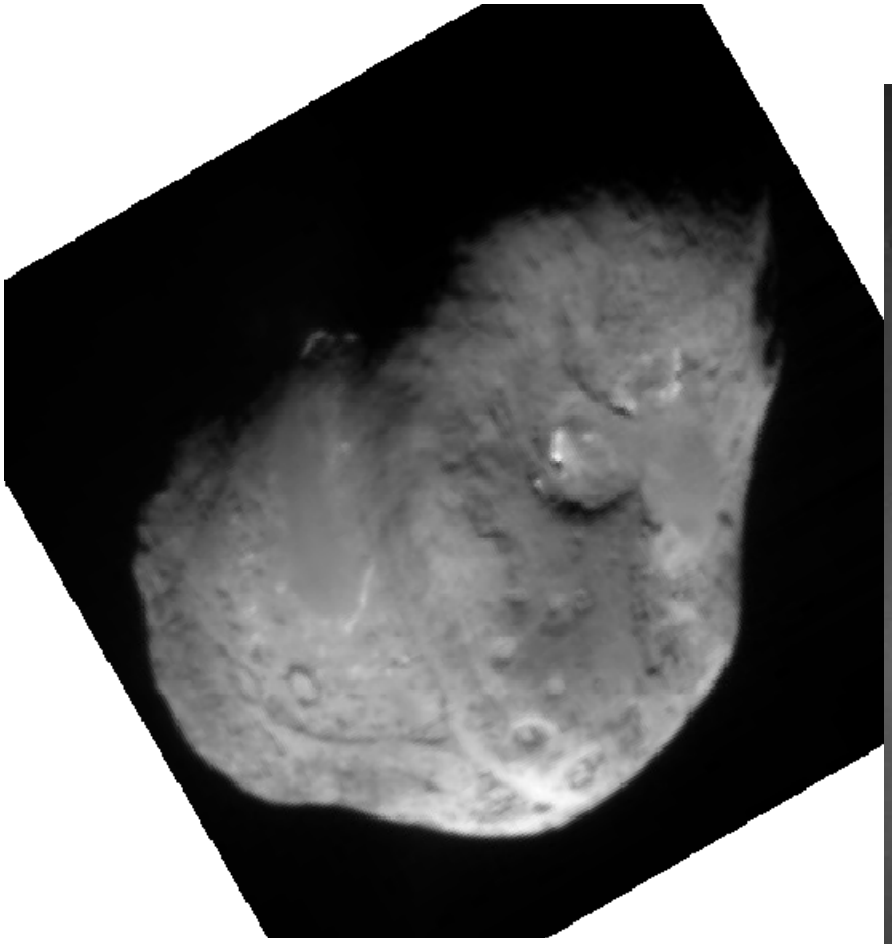
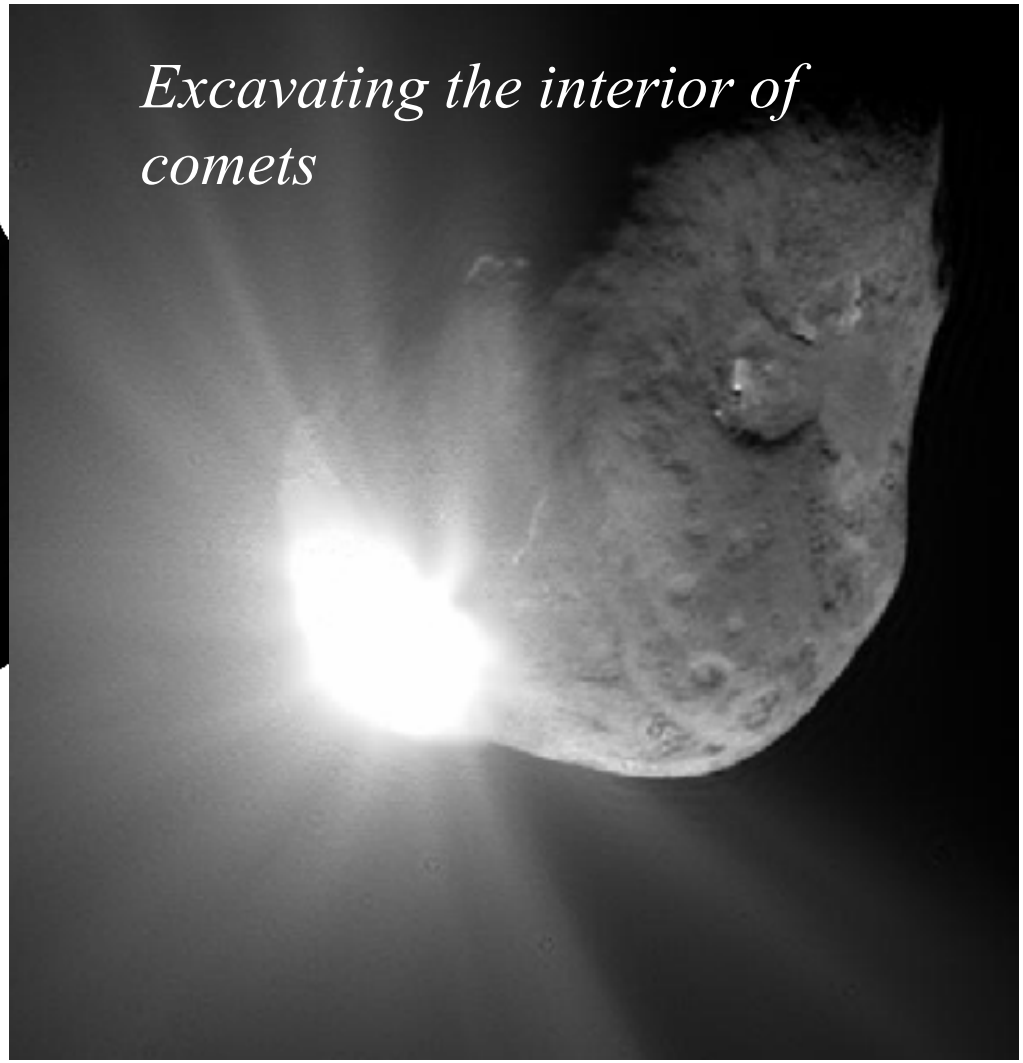
Comet Tempel 1 before and after Deep Impact





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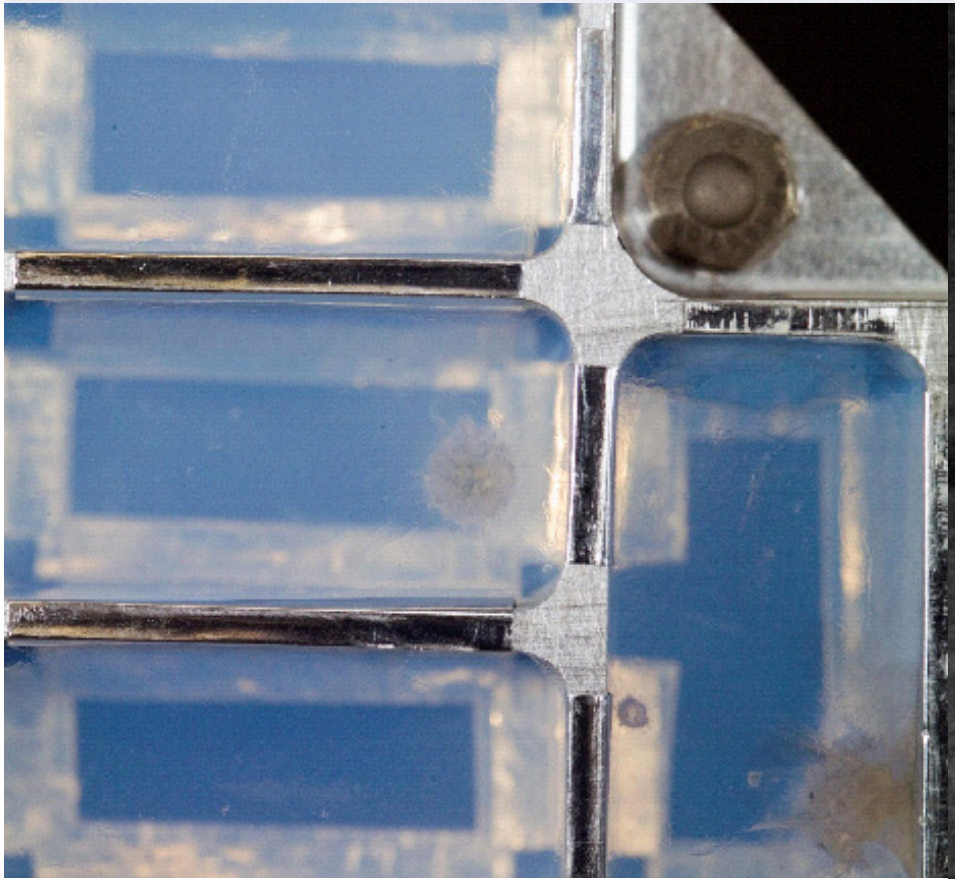
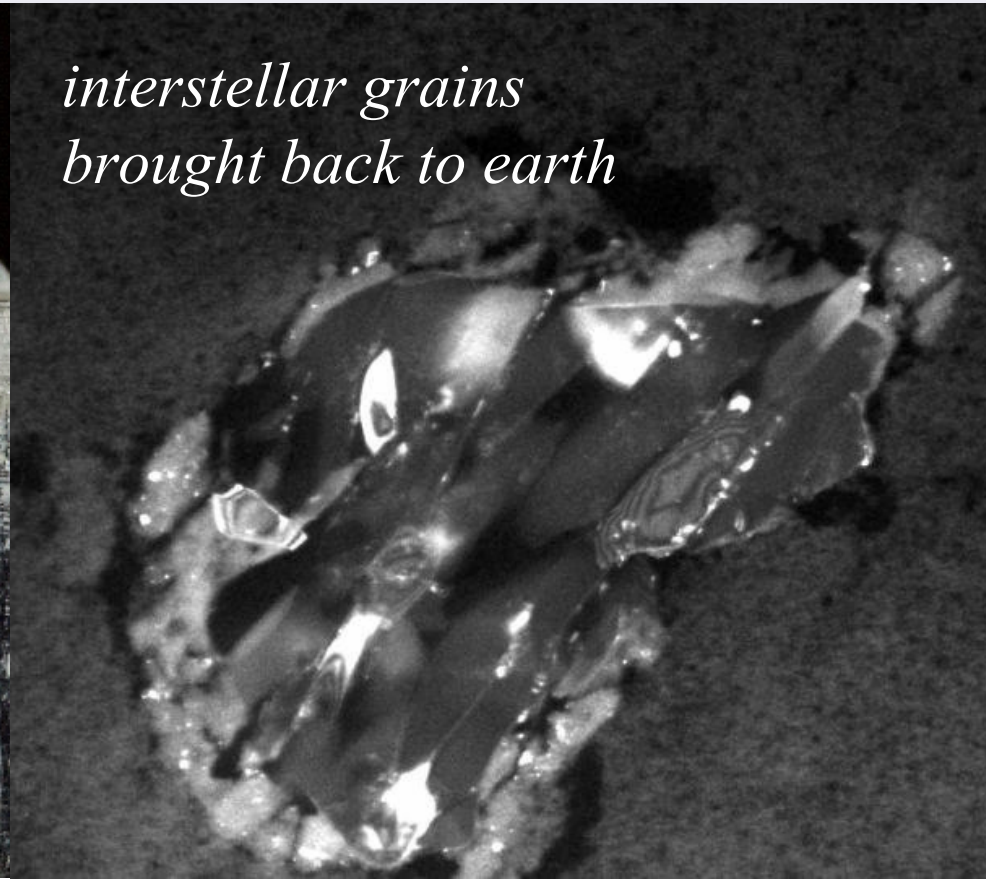
Comet particle in Stardust's aerojel, and 2 micron particle extracted from aerojel





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Spitzer sees center of the galaxy

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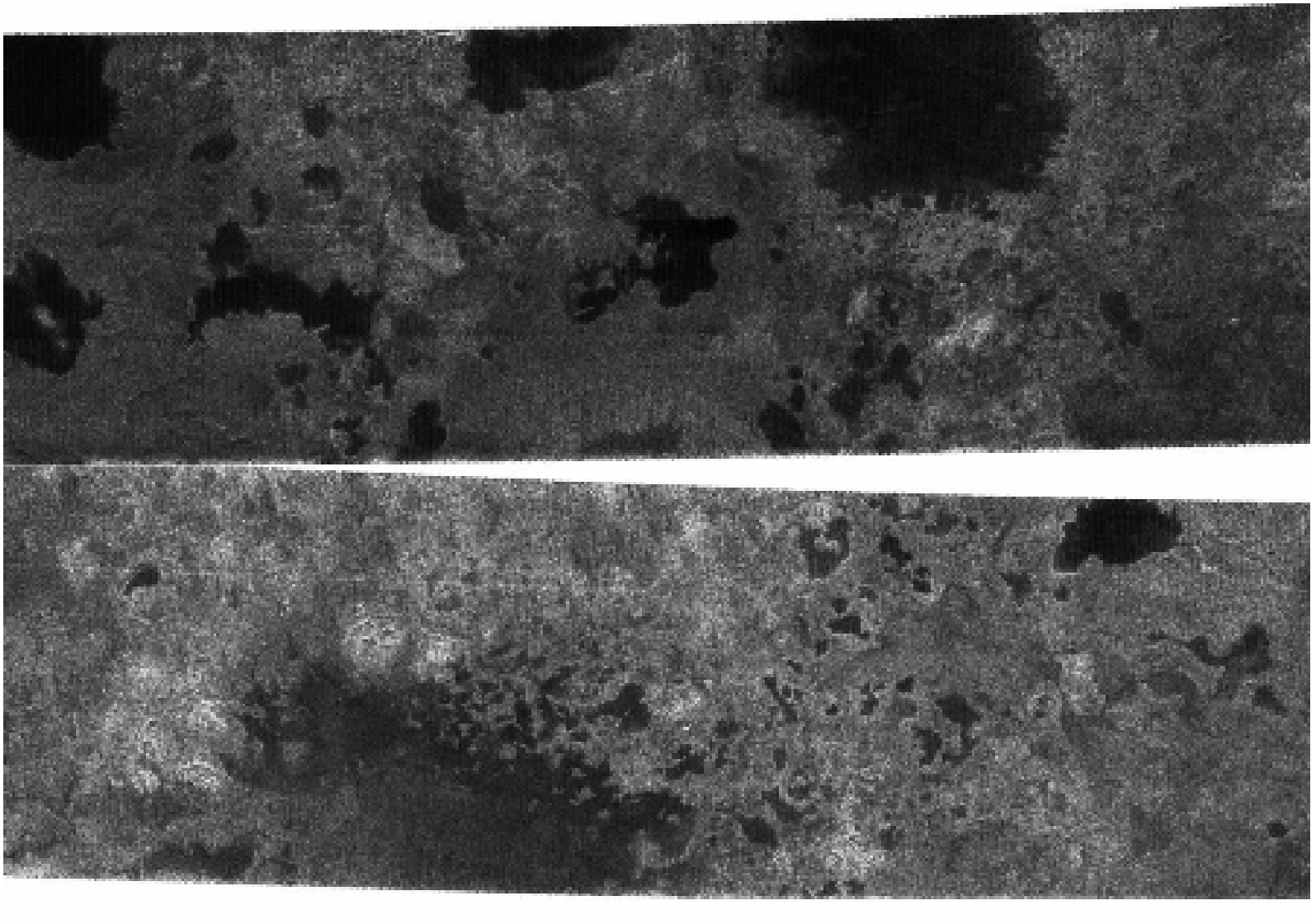
Cassini's Titan radar sees "great lakes" near Titan's north pole



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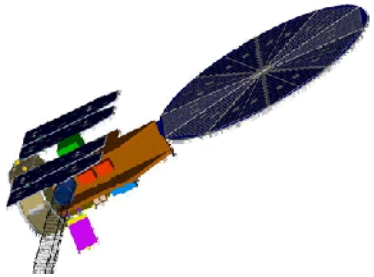
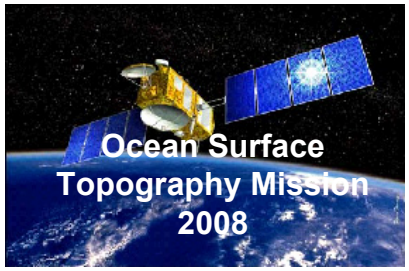
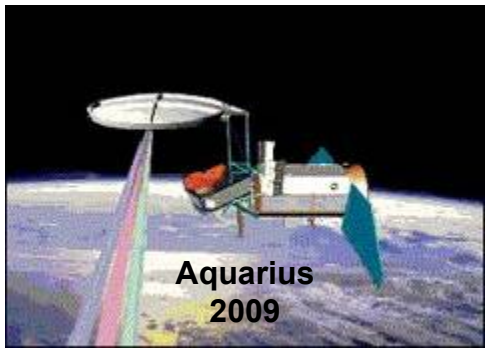
Looking ahead:
Missions under development







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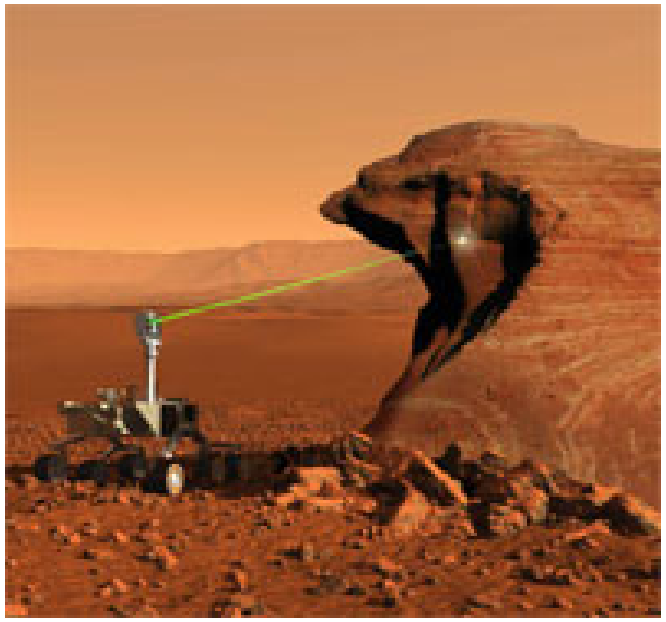
Mars Science Laboratory: Was Mars a Habitat for Life?

- **Was Mars a habitat for life?**
  - **Largest Rover Mission to date to be Launched in 2009 arrive 2010**
  - **Will search for carbon based compounds – the building blocks of life as we know it**
  - **On board laboratory is the most advanced suite of instruments for scientific studies ever sent to the Martian surface**
  - **Enables a huge step in Mars surface science and exploration capability**
    - **Landing heavy payload on SFC needed for sample return**
    - **Precision landing to previously inaccessible sites**
    - **Demonstrate long-range SFC mobility (20km)**



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Mars Science Laboratory: Technology

- **Spacecraft**
  - **Viking type 4.5 m Aeroshell for entry deceleration**
  - **Precision guided entry enabling 20km sfc target radius**
  - **Viking type parachute system deployed supersonically**
  - **Power Descent Vehicle with retrorocket landing engines**
  - **Skycrane to lower rover/lander to surface on tether**

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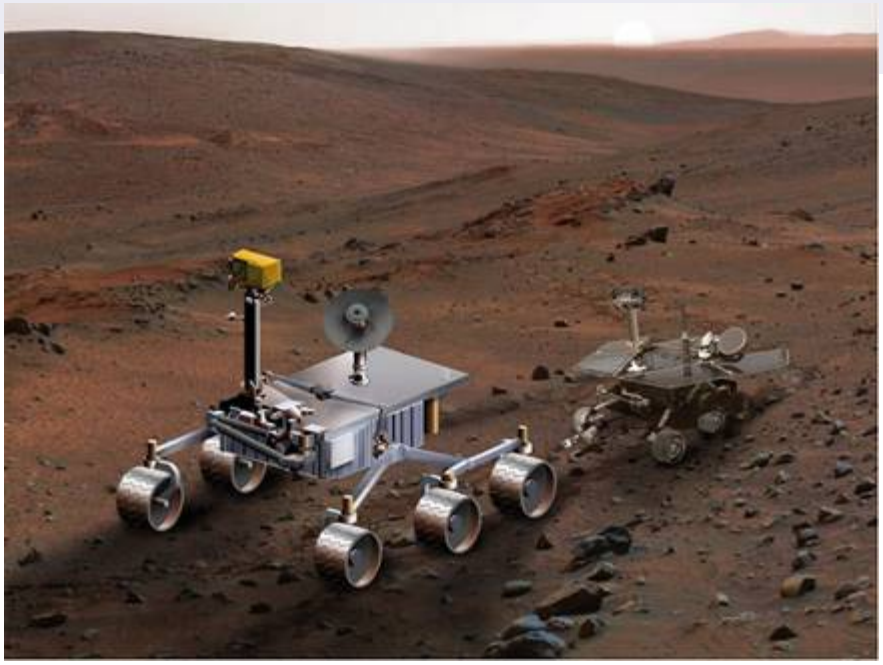
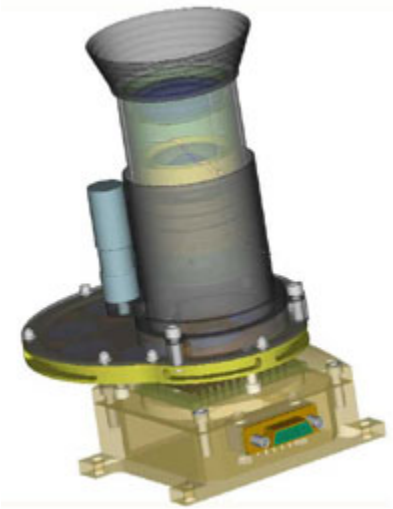
Mars Science Laboratory: Technology

- **Rover: largest and most capable**
  - 6 wheel mobility system
  - 850kg with an RTG power source
  - More than twice the size of MER
  - 20km range
  - Larger temp capability





Some of the Instruments

- X-ray spectrometer
- Chem-cam
- Rock core driller and crusher
- SAM:Laser and mass spec
- RAD – Radiation detector
- REMS – Weather monitor

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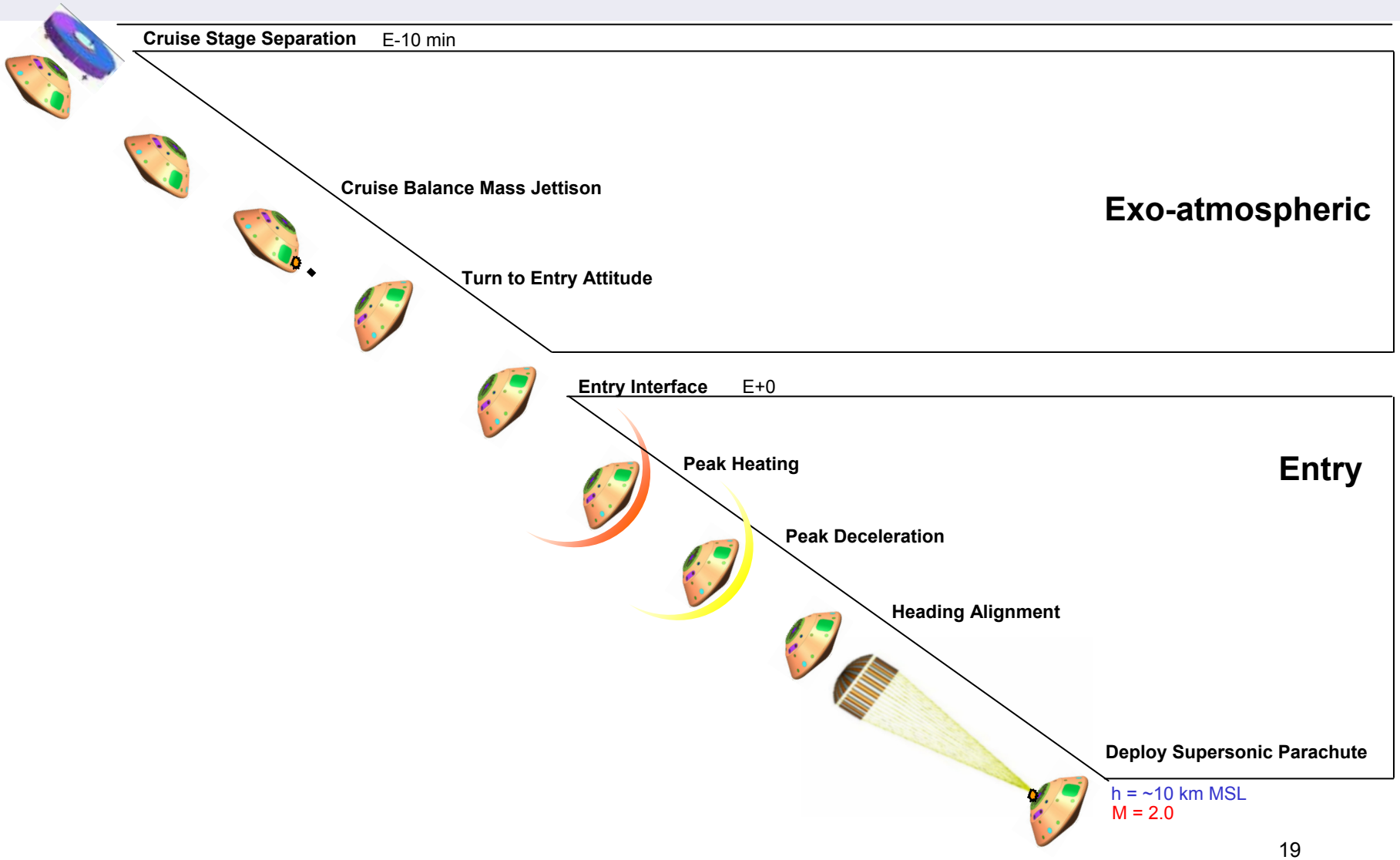
Mars Science Laboratory: EDL



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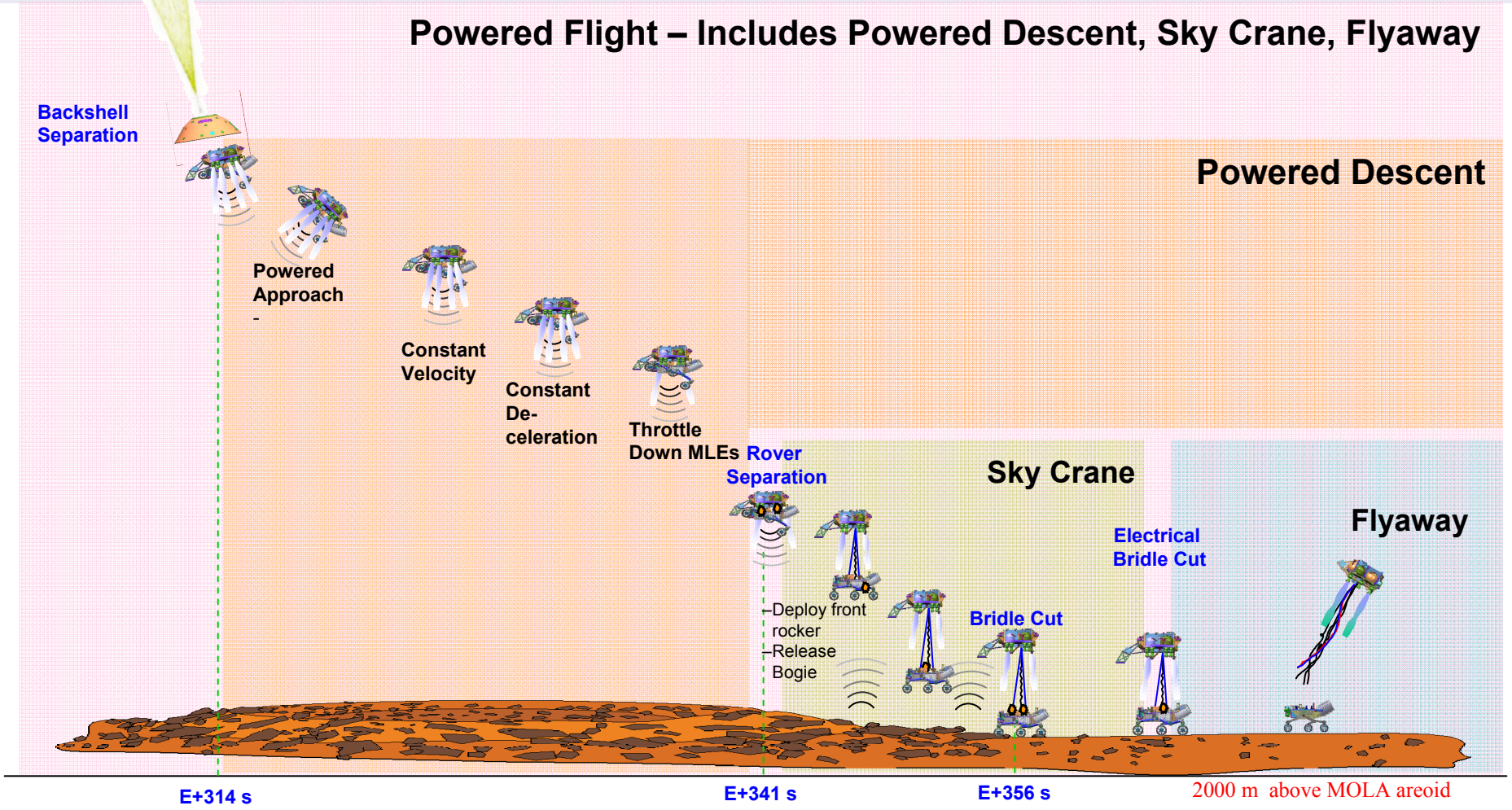
Mars Science Laboratory: EDL



X-Band Tones →
UHF 2 kbps →

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Acknowledgements

http://mars.jpl.nasa.gov website for images